TECHNICAL REPORT

ISO/TR 3834-6

First edition
2007-02-15

Quality requirements for fusion welding of metallic materials —

Part 6: Guidelines on implementing ISO 3834

Exigences de qualité en soudage par fusion des matériaux métalliques —

Partie 6: Lignes directrices pour la mise en application de l'ISO 3834

Reference number
ISO/TR 3834-6:2007(E)

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 3834-6 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 10, *Unification of requirements in the field of metal welding*.

ISO/TR 3834 consists of the following parts, under the general title *Quality requirements for fusion welding of metallic materials*:

— *Part 1: Criteria for the selection of the appropriate level of quality requirements*

— *Part 2: Comprehensive quality requirements*

— *Part 3: Standard quality requirements*

— *Part 4: Elementary quality requirements*

— *Part 5: Documents with which it is necessary to conform to claim conformity to the quality requirements of ISO 3834-2, ISO 3834-3 or ISO 3834-4*

— *Part 6: Guidelines on implementing ISO 3834* [Technical Report]

Requests for official interpretations of any aspect of this part of ISO 3834 should be directed to the Secretariat of ISO/TC 44/SC 10 via your national standards body, a complete listing of which can be found at http://www.iso.org.

Introduction

Welding is a special process in that the final result may not be able to be verified by testing. The quality of the weld is manufactured into the product, not inspected. This means that welding normally requires continuous control or that specific procedures be followed, or both. ISO 3834 deals with quality requirements in welding and has been prepared in order to identify those controls and procedures.

ISO 3834 is not a quality system standard intended to take the place of ISO 9001, but a useful, additional tool for use when ISO 9001 is applied by manufacturers, in which case the meeting of its requirements needs to be recorded in certificates or documentation. However, ISO 3834 can be used independently of ISO 9001.

ISO 3834 is intended for the fusion welding of metallic materials, and its application is independent of the products manufactured. However, its principles and many of its detailed requirements are also relevant for other welding and welding-related processes.

Among other International Standards covering resistance welding and thermal spraying are ISO 14554 and ISO 14922, respectively.

One of the aims of ISO 3834 is to define requirements in the field of welding so that contracting parties or regulators do not have to do this themselves. A reference to a particular part of ISO 3834 should be sufficient to demonstrate the capabilities of the manufacturer to control welding activities for the type of work being done. This concept also applies to committees responsible for drafting product standards.

ISO 3834 does not in itself require external assessment or certification. However, assessments by customers and certification by independent bodies are growing trends in commercial relations and the standard can serve as a basis for these purposes, as well as for the demonstration of performance by those manufacturers implementing it.

Quality requirements for fusion welding of metallic materials —

Part 6:
Guidelines on implementing ISO 3834

1 Scope

This part of ISO 3834 gives guidelines for the implementation of requirements given in the other parts of ISO 3834, and is intended to help manufacturers and users select that part of ISO 3834 appropriate to their needs. It is expected that they will already be familiar with ISO 3834 as a whole.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3834-1:2005, *Quality requirements for fusion welding of metallic materials — Part 1: Criteria for the selection of the appropriate level of quality requirements*

ISO 3834-2, *Quality requirements for fusion welding of metallic materials — Part 2: Comprehensive quality requirements*

ISO 3834-3, *Quality requirements for fusion welding of metallic materials — Part 3: Standard quality requirements*

ISO 3834-4, *Quality requirements for fusion welding of metallic materials — Part 4: Elementary quality requirements*

ISO 3834-5, *Quality requirements for fusion welding of metallic materials — Part 5: Documents with which it is necessary to conform to claim conformity to the quality requirements of ISO 3834-2, ISO 3834-3 or ISO 3834-4*

3 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

IWE international welding engineer

IWS international welding specialist

IWT international welding technologist

NDT non-destructive testing

PWHT post-weld heat treatment

pWPS preliminary welding procedure specification

WI work instruction

WPQR welding procedure qualification record

WPS welding procedure specification

4 Using ISO 3834

4.1 General

ISO 3834-1 provides criteria for the selection and use of ISO 3834 as a whole. The following subclauses identify different ways whereby the manufacturer may select or be required to adopt ISO 3834.

4.2 Product standards

Where product standards require control of fusion welding, ISO 3834 should be used to organize those welding activities.

Product standards where compliance with ISO 3834 is required include EN 1090, EN 12732, EN 12952, EN 13445 and EN 15085.

4.3 Purchasers and users

Purchasers and users of welded products may specify in contract documents that manufacturers demonstrate their competence by compliance with ISO 3834.

4.4 Quality management systems in accordance with ISO 9001

Since ISO 9001 does not include specific requirements for welding activities, ISO 3834-2, ISO 3834-3 and ISO 3834-4 should be used.

4.5 Quality management systems other than ISO 9001

For welding activities in quality management systems other than ISO 9001 that do not include specific requirements for welding activities, ISO 3834-2, ISO 3834-3 and ISO 3834-4 should be used.

4.6 Manufacturers

Whenever manufacturers wish to give evidence of their competence in fusion welding activities, the appropriate part of ISO 3834 should be used.

5 Incorporating ISO 3834 in product standards

An important group of users of ISO 3834 is the committees that draft product standards at the international, regional and national levels. ISO 3834-2, ISO 3834-3 and ISO 3834-4 provide a range of quality requirements for welding. Committees drafting product standards are encouraged to select a part, or parts, of ISO 3834 that provide the appropriate quality requirements for the products to be manufactured, taking account of the selection criteria given in ISO 3834-1:2005, Clause 5. Each part of ISO 3834 is designed to provide a complete set of quality requirements; additional requirements should not need to be specified unless very compelling reasons exist. In case of doubt, or where additional requirements are being considered, consultation with ISO/TC 44/SC 10 is recommended.

Where welding is involved in the manufacture of a product, the standards committee may define the documents to be applied or else take them from the ISO documents specified in ISO 3834-5. The committee should also select the appropriate quality requirement standard or standards to be applied. Where a series of levels exist in the ISO documents in ISO 3834-5, e.g. for welding procedure qualification, it would be satisfactory for the standardization committee to select only those that would be acceptable. The development of tables linking parts of ISO 3834 (with or without other quality-related standards such as ISO 9001) to requirements other than those given in ISO 3834, is strongly discouraged.

6 Using other documents with ISO 3834

Full conformity with ISO 3834-2, ISO 3834-3 and ISO 3834-4 may be achieved either by adopting the ISO documents according to ISO 3834-5, or applying other standards that provide equivalent technical conditions.

Standards that do not provide equivalent conditions may be adopted if they are referenced in product standards that are used in full by the manufacturer.

Product standards that have been operated satisfactorily in service may be considered by a manufacturer as being recognized for application with ISO 3834. Where a manufacturer bases his demonstration of conformity to ISO 3834 on product standards, it is the responsibility of the manufacturer to apply the corresponding standards — whether separately specified or incorporated in the product standard — in their totality. It is the responsibility of the manufacturer to demonstrate technically equivalent conditions when standards other than the ISO documents according to ISO 3834-5 are applied. Certificates issued following assessment by independent certification organizations or claims of compliance by a manufacturer with any part of ISO 3834 should clearly identify the documents used by the manufacturer and provide or reference evidence of technical equivalence as applicable.

7 Documentation and quality systems

7.1 Documentation

In any control system there is a need for documentation. The term *documentation* embraces a range of different types of documents such as procedures, records, instructions and certificates (see Table 1).

ISO 3834-2, ISO 3834-3 and ISO 3834-4 require certain documents to be produced. Annex A gives examples of the types of documents which may be used by manufacturers.

Table 1 — Examples of different types of welding-related documents

Type of document	Description [a]	Examples of welding coordinator
Procedure	Description of welding-related activity	Description of the role (tasks, responsibilities and authority) of welding coordinator Description of the handling of welding consumables and parent metals Description of how welding procedure tests are carried out Description of how welder's qualification is carried out
Record	Report of welding-related activity	Record from a procedure test (WPQR) Record from a welder qualification test Welding record
Instruction	Description of welding-related operation	Welding procedure specification (WPS) Work instructions
Certificate	Verification of welding-related operation	Welder's qualification test certificate Material test report

[a] Not to be confused with a definition of the terms.

7.2 Quality system

ISO 3834 does not specifically require a quality management system. However, ISO 3834-1:2005, Clause 6, identifies those elements that could be considered as complementing ISO 3834 if a quality management system were to be adopted. Of these, a most important one is document control, and manufacturers are expected to implement a document control procedure ensuring that

— documents are maintained up to date,

— those in receipt of documents are identified,

— the latest issues of the documents are available at locations where they are used,

— obsolete documents are withdrawn,

— records are archived to avoid deterioration and to enable retrieval, and

— records are not destroyed without authorization.

Some of the records generated as part of this system require updating at periodic intervals. These include calibration/validation records and welder qualification records.

Manufacturers who operate a quality management system conforming to ISO 9001 are expected to have a documented system in place covering those elements identified in ISO 3834-1:2005, Clause 6.

The effectiveness of the welding control system will depend to a large extent on the input from top-level management and their role in monitoring performance and implementing action when weaknesses are detected. Applying management review and internal audit ensures top management involvement in the welding control system and enables the monitoring of performance and introduction of measures to overcome identified deficiencies. Figure 1 provides a summary of critical measures in the welding control system to assist management review of the performance of the welding control system.

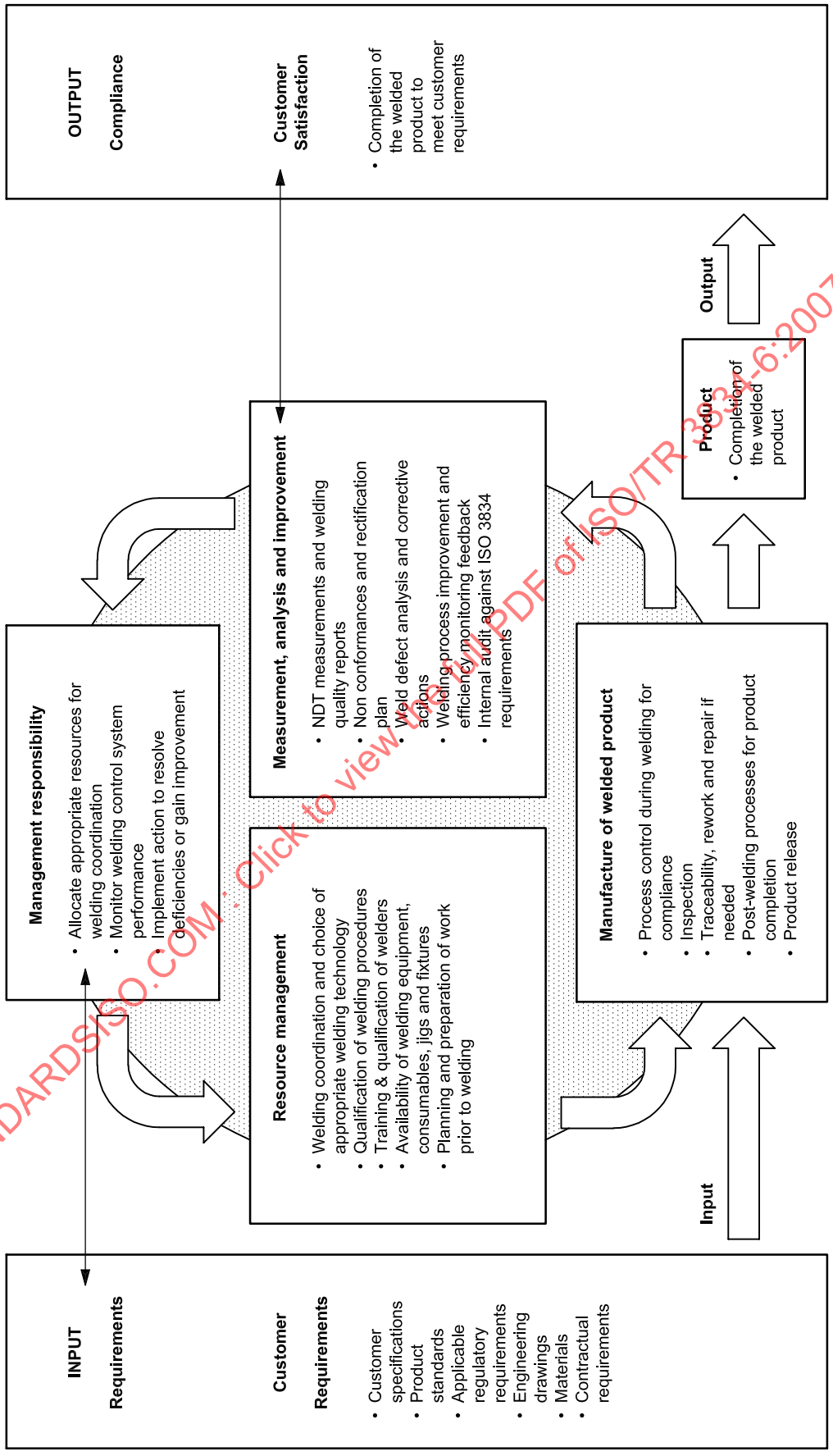

Figure 1 — Summary of welding system control measures

8 Selecting the level of quality requirements

ISO 3834 incorporates three levels of quality requirements that may be included in product standards, regulations and contracts or selected by a manufacturer. The level selected will depend on the nature of the product being manufactured, the conditions under which it is to be used and the range of products manufactured. In ISO 3834-1, it is stated that the standard can be applied in a variety of industrial situations. The following criteria are identified as being those applying in the selection of the most suitable level:

a) the extent and significance of safety critical products;

b) the complexity of manufacture;

c) the range of products manufactured;

d) the range of different materials used;

e) the extent to which metallurgical problems can occur;

f) the extent to which fabrication imperfections (e.g. misalignment, distortion, weld imperfections) affect product performance.

Product standards that require compliance with ISO 3834 emphasize two critical areas in the choice of the level of quality requirements: the safety-critical nature of the products and the significance of dynamic loading in the product service environment.

In general, the standard level of quality requirements should be suitable for the broad range of products having a normal safety critical component and that could experience dynamic loading. Such products would be manufactured from conventional materials where the weldability is known and the precautions to be taken to ensure mechanical performance and defect-avoidance are well documented. Products having a very limited safety component and that are subjected to only moderate static loads with minor dynamic components would normally only require the elementary level of quality requirements.

Where there are significant safety factors with high static and dynamic loadings and the materials are designed for high performance applications, the comprehensive level of quality requirements would be appropriate. However, there may be situations where, because of the innovative nature of the design or the use of novel production processes, the comprehensive level of quality requirements is selected in place of the standard level.

It is not possible in these guidelines to allocate specific parts of ISO 3834 to particular types of product. This is because there can be different levels of complexity in the design, materials and fabrication processes in any product group. Selection of these levels is the responsibility of product standards committees, or of those purchasing or manufacturing particular constructions or groups of constructions.

The sequence of activities involved in the selection of the welding quality requirements is summarized in the flow chart shown in Figure 2.

It is stated in ISO 3834-1 that a manufacturer compliant at a particular level of quality requirements is also compliant at a lower level. Thus, a manufacturer demonstrating compliance with ISO 3834-2 is also compliant with ISO 3834-3 and ISO 3834-4. This could be relevant for a manufacturer producing a range of products, some of which may require comprehensive quality requirements, while others require only standard or elementary quality requirements. By such means, a manufacturer can apply the comprehensive quality requirements to those products where that comprehensive level is applicable, while applying the requirements of the standard or elementary parts to products where these are more appropriate.

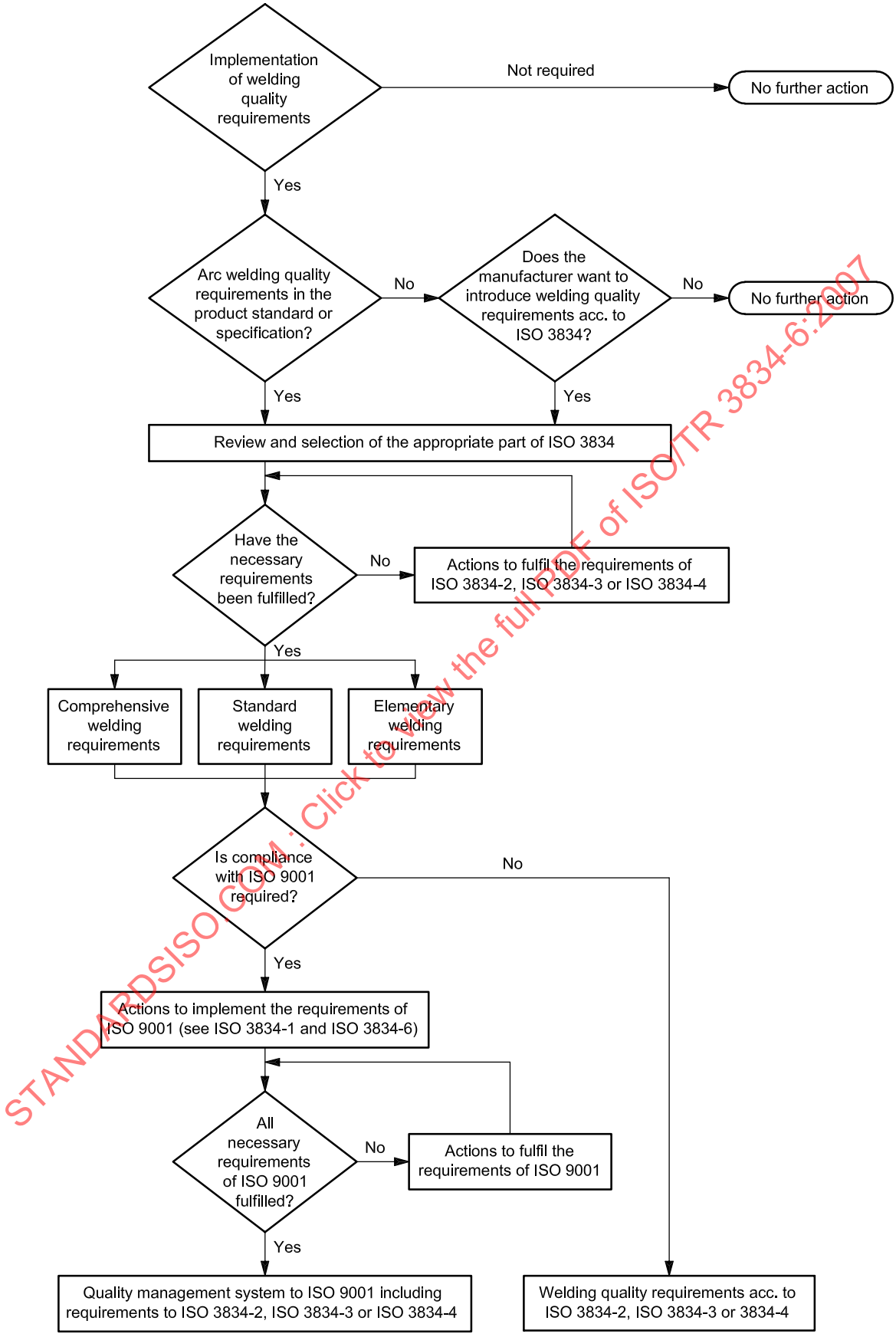

Figure 2 — Welding quality requirements — Flow diagram

9 Implementation in fabrication

9.1 General guidelines for implementation

9.1.1 Basic principles

ISO 3834 specifies requirements for a number of different categories of activity, notably those relating to

a) the manufacturer's procedures for the overall control of welding as a special process,

b) technical instructions for production (e.g. welding procedure specifications for ISO 3834-2 and ISO 3834-3), and

c) demonstration of personnel competence, capability and suitability (e.g. welder's qualifications).

Each category is examined more fully below. Further comments relate to the manufacturer's organization, the implementation in an ISO 9001 environment and, finally, individual elements of the control.

9.1.2 Implementation

Many manufacturers apply requirements relating to procedures and instructions for production as well as the documentation of competence, capability and suitability of the personnel. For such manufacturers, ISO 3834 should not incur major change or cost. However, some manufacturers may require more significant action, for one or more of the following reasons.

a) Where the implementation of ISO 3834 coincides with a transition to new national or internationally recognized product standards, such transitions may require new measures that have not been previously applied, such as qualification testing of welders and welding procedures and the training or employment of welding coordination personnel, to ensure a knowledge base for the types of product manufactured.

b) Customers may impose compliance with the requirements of ISO 3834 on manufacturers who have previously operated using very different practices.

c) National or regional regulations could require compliance with ISO 3834 of manufacturers in specific industrial sectors in order for their products to be granted approval for use in that country or region. Such demands may involve significant changes to the previously applied practices.

Where such actions become necessary, it should be noted that ISO 3834 reflects good practice in the manufacture of products where welding is an important production process. Compliance with ISO 3834 confers confidence for the manufacturer and the customer alike that the product will be manufactured properly and should not suffer premature failure during service life as a result of manufacturing deficiencies, provided a suitable programme of inspection and maintenance is undertaken.

9.1.3 Control of welding

Because welding is a special process and the consequences of poor welding can be severe, it is necessary to exercise controls to ensure that the welding is performed correctly, and that the required inspections are carried out thoroughly for the products manufactured. These controls and their subjects include

— verification of welding procedures and the capabilities of welding personnel,

— availability, suitability and maintenance of equipment,

— identification of product requirements,

— the manner in which sub-contracting is carried out,

— the level of production planning,

— storage and handling of parent metals and welding consumables,

— operation and performance of inspection,

— identification and traceability of product and work in progress,

— correction of product non-conformance, and

— the extent and storage of quality records.

Such controls should specify what it is that is to be controlled, how it is controlled (if necessary, by reference to one or more procedures or standards), who has been allocated tasks and responsibilities in the control system, and how individual aspects of the control system are to be reported and documented.

9.1.4 Production procedures

9.1.4.1 Technical documentation

ISO 3834 specifies a number of technical instructions, procedures, specifications and records in order to ensure the effectiveness of the welding control system. Those production activities that require such technical documentation are speficied in ISO 3834-1:2005, Annex A. Where a particular activity is not within the range of production activities, e.g. post-weld heat treatment (PWHT), it is not necessary for the manufacturer to address these in the control system.

Examples of documentation that manufacturers have found useful for their control systems are given in Annex A.

9.1.4.2 Welding procedure qualification

The following International Standards give information on specification and qualification of welding procedures — ISO 15607 and ISO 15609 — and five general methods for qualification of welding procedures:

— tested welding consumables (ISO 15610);

— previous welding experience (ISO 15611);

— standard welding procedure (ISO 15612);

— pre-production welding test (ISO 15613);

— welding procedure test (ISO 15614).

If the product standard does not specify which method (ISO 15610 to ISO 15614) is to be used, this should be agreed on between the contracting parties.

When a welding test is carried out (welding procedure or pre-production welding tests), the results obtained are recorded in a welding procedure qualification record (WPQR). The steps are summarized in Table 2.

Table 2 — Documentation with regard to welding procedure qualification

Task	ISO 3834-2	ISO 3834-3	ISO 3834-4
Preliminary planning of qualification	pWPS	pWPS	Work instruction
Qualification	WPQR [c]	WPQR [c]	No documentation required [a c]
Specification of welding procedure	WPS	WPS	Work instruction [a]
Work instruction (WI)	WPS or dedicated WI (optional)	WPS or dedicated WI (optional)	Verbal communication or WI
Documentation of process	Production report (optional, usually not required)	Not relevant [b]	Not relevant

[a] The welding procedures specifications (pWPS) applied in an ISO 3834-4-context are well established and are considered as "known to be satisfactory". The WPS can usually be reduced to a specification of welding process, parent metals and welding consumables. Furthermore, the supplier of the welding consumables may have indicated wide ranges for the essential welding parameters which then have to be adhered to.

[b] Records of actual welding data during fabrication may not be useful unless the instruments for measurement are calibrated/verified.

[c] The WPQR should be signed by the examiner/examining body. According to ISO 15607:2003, Table B.1, the pWPS, WPS and WI are prepared and signed by the responsible welding coordinator (or welding supervisor if ISO 3834-4 applies) on behalf of the manufacturer.

When standard welding procedures are used (see ISO 15612), preliminary planning of qualification of welding procedures is not relevant.

9.1.4.3 Other processes

The principles for qualification of other production processes are to some extent similar to those of welding procedure qualification. The same general methods for welding procedure qualification (see 9.1.4.2) may also be applied for other production documentation used in connection with welding fabrication.

Examples of documentation for other fabrication processes are outlined below.

— **Non-destructive testing**

Non-destructive testing (NDT) of welds is often specified in product standards and the normal practice is to apply a standard procedure for the NDT method used, prepared on the basis of the relevant NDT standard. An *NDT report* should always be prepared detailing the results of the test and sentencing the weld. This report normally includes a record of the critical NDT parameters used during the test.

— **Post-weld heat treatment**

The situation for post-weld heat treatment (PWHT) is analogous to the one described above for NDT. A heat treatment procedure is required as well as a report of heat treatment data. Quality requirements for heat treatment are given in ISO/TR 17663.

— **Thermal cutting**

Documented procedures are not generally required for thermal cutting because reliance is placed on the skill and competence of the operator. In some cases, however, such as when cutting sensitive materials, for which experience is limited or where there is a risk of hard zones at the cut edges that could be harmful in the final product, documented instruction may be necessary.

9.2 Organization

The term “manufacturer” is widely used as a designation for the entity that includes responsibility for welding coordination. However, strictly speaking, control of welding is performed within an organization by a body of people working under the control of a single team of welding coordinators (as defined in ISO 14731). An organization in this context is often, but not always, the same as a legal body. Some typical situations are outlined in Table 3, which illustrates the principles.

Table 3 — Organization and tasks

Situation	Comments
Large corporation comprising a number of companies or factories, each having a team of welding coordinators responsible to each company or factory management.	Feasible, but ISO 3834 should be implemented independently for each company or factory. Each company or factory would normally consider all other companies or factories as sub-contractors.
Large corporation comprising a number of factories, controlled by a single team of welding coordinators referring to the corporate management.	Corporate implementation involving all factories is feasible. Any factories performing welding which do not comply should not be permitted to deliver any welded product to a factory having implemented ISO 3834.
Manufacturer (main contractor) wishing a sub-contractor to work under his ISO 3834-control.	Feasible only if the main contractor's authorized welding coordinators have the power and the means to efficiently control the sub-contractor’s welding activities.

Welding procedure specifications that are qualified by a welding procedure test, e.g. according to ISO 15614, by a manufacturer in one workshop, may be applied in different workshops of the same manufacturer if a common control system according to ISO 3834 including the same welding coordination personnel is operated by the manufacturer.

All organizations which do not comply to the above are designated as “sub-contractors” for the purposes of ISO 3834. If a sub-contractor does not comply with ISO 3834 in his own right, the manufacturer should ensure that he can meet the appropriate requirements of the standard for each particular contract.

10 Interpretation of particular clauses in ISO 3834

10.1 Requirements review and technical review

The manufacturer has to demonstrate, e.g. by completion of a checklist or by written minutes from a contract or technical review meeting, that each requirement in the appropriate part of ISO 3834 has been fully covered. The aspects given in the standard are not intended to be exhaustive; further matters relevant to a particular contract or design requirement should be considered.

The overall intent is to ensure that the manufacturer properly understands the technical requirements and that the product can be manufactured in accordance with the contract.

Welding coordination according to ISO 14731 should be specified for this activity.

10.2 Sub-contracting

The manufacturer should ensure that any sub-contracted welding-related activities, including welding, NDT, inspection, heat treatment, maintenance of equipment and calibration, comply with the requirements of the contract specification to the satisfaction of the welding coordinator with assigned responsibilities in this area.

Sub-contractors who deliver welding or ancillary services may comply with the same or a higher level of ISO 3834 as the main contractor. However, a lower level may be appropriate in particular cases, depending on the extent of the sub-contract and the services or products provided.

For various reasons, it may not always be possible to sub-contract work to organizations that are compliant with any of the quality level parts of ISO 3834. It is the manufacturer's responsibility to ensure the welding or related activities are properly controlled according to relevant items of ISO 3834. This may require auditing of a sub-contractor's premises when welding is being carried out and being involved in welder and welding procedure qualifications. If the manufacturer has suitable welding procedure specifications, it may be expedient to offer these to the sub-contractor and to monitor their application. Product inspections may also be undertaken in conjunction with the manufacturer. Sub-contractors providing associated services, such as PWHT, NDT or inspection, may be audited if they do not have appropriate certification for their activities and qualified personnel from industry-related schemes. More extensive supervision and surveillance may become necessary if the initial audits reveal excessive non-conformance.

When contractual or legal requirements specify a particular part of ISO 3834, sub-contractors should comply with that level or higher. However, if ISO 3834-2 or ISO 3834-3 are required, a sub-contractor working according to ISO 3834-4 may be acceptable for producing simple welded products. Nevertheless, this could necessitate a concession from the customer/authority involved.

If no contractual or legal requirements are enforced, the manufacturer should, on his own initiative, ensure either that sub-contractors comply with ISO 3834 at the appropriate level or that measures are taken that provide adequate controls for the work to be carried out.

10.3 Welding coordination

10.3.1 General

Welding coordination according to ISO 14731 addresses the management and execution of those manufacturing and technical activities undertaken to control the welding. It should be noted that welding coordination is usually performed by various categories of personnel, many of whom are not traditionally considered to be part of the welding technology team. The following points are highlighted.

a) Large organizations performing extensive and complex welding activities will usually employ a number of persons who deal exclusively with the control of welding. Those persons can have titles such as *welding engineer* or *welding technologist* and are normally recognized as full-time welding coordinators.

b) In small organizations, similar duties may be allocated to persons having other titles (e.g. production manager, foreman) and performing other tasks in addition to welding coordination (part-time welding coordinators).

c) Some welding coordination activities, typically related to the storage and handling of consumables, and maintenance and calibration of equipment, can be allocated to persons having titles which bear little connection to welding. Such people are generally qualified for only a few specialized welding coordination tasks.

d) Some manufacturers allocate the responsibility for some of the detailed planning to welders or welding operators. In such cases, the manufacturer should ensure that the welders and welding operators have the necessary knowledge and competence.

e) Control of inspection and testing activities that are also welding coordination activities are usually performed by persons bearing titles such as *welding inspector*, *NDT engineer* or *quality manager*. However, in smaller organizations, such activities may be allocated to foremen or other personnel.

10.3.2 Welding coordinator

ISO 3834-2 and ISO 3834-3 require application of ISO 14731, which presents “the human aspect” of welding control and, as such, is an important standard. Within the system, each control activity, e.g. control of maintenance of welding equipment, is performed by one or more persons, normally employed by the manufacturer. ISO 3834 identifies requirements for each element of welding control. In allocating these welding coordination tasks and responsibilities, the manufacturer should

a) identify the separate control systems and prepare lists of all tasks and responsibilities and who they are allocated to,

b) check all of the listed tasks and responsibilities to ascertain that all the activities listed in ISO 14731 have been incorporated into the control system and that they have been properly allocated to a person or persons,

c) identify the criteria for competence in terms of qualification, experience and training for each of the welding coordination positions, and

d) ensure the competence of those persons nominated as welding coordinators by way of experience, training and/or qualification is adequate for their allocated tasks.

It must be emphasized that the qualification needed for each welding coordinator is a consequence of the way in which the manufacturer has allocated tasks and responsibilities in his organizational structure.

ISO 14731 uses the term *responsible welding coordinator* to identify the person or persons having an adequate level of welding technical knowledge for the range of products manufactured. All manufacturers should appoint at least one responsible welding coordinator. The expectation is that a responsible welding coordinator is the person nominated by the manufacturer as having the competence to make decisions and to sign documents which affect product quality. The responsible welding coordinator has an overall responsibility for monitoring welding activities and for taking action when welding has not been correctly performed.

In ISO 14731:2006, Annex A refers to educational systems established by the International Institute of Welding (IIW). It states that customers and authorities should consider a responsible welding coordinator having gained an appropriate diploma to be “qualified by definition”. Thus, a reference to the IIW education and diplomas should be accepted at face value by customers and authorities. ISO 14731:2006, Annex A, does not prevent the manufacturer from referring to any other qualification for the responsible welding coordinators. The manufacturer would be expected, however, to confirm the adequacy of such alternative qualification for customers and authorities.

10.3.3 Correlation between ISO 14731 welding coordination knowledge and ISO 3834 quality levels

ISO 14731 specifies two types of knowledge and experience required of welding coordinators:

a) general technical knowledge;

b) specialized technical knowledge in welding and related processes, relevant to the assigned task.

In addition, it defines three levels of technical knowledge for responsible welding coordinators:

— comprehensive technical knowledge;

— specific technical knowledge;

— basic technical knowledge.

ISO 3834 presents three levels of quality requirements for welding. The three levels according to ISO 3834 and those according to ISO 14731 are correlated for some, but not for all applications.

The following factors essentially affect this correlation:

a) the technical complexity of the welding operations, in particular the weldability of the parent metals;

b) the complexity of the equipment used for welding (equipment such as numerically controlled equipment and welding robots may require greater production control than for manual metal arc welding);

c) the production volume (mass production necessitates detailed production planning and control in order to minimize fabrication costs);

d) the weld quality level (greater amounts of surface and volumetric inspection and more stringent acceptance criteria require more stringent control to avoid excessive repair or rejection).

Table 4 illustrates correlation where only one of the factors (a), (b), (c) or (d) is of significance. It should be noted that many manufacturers will have to take more than one factor into consideration when specifying the qualification and experience required of the responsible welding coordinator(s); nevertheless, the table illustrates the principles to be followed. It is separately recommended that welding coordinators have appropriate manufacturing experience.

Table 4 — Correlation between ISO 3834 and ISO 14731

Decisive factor	Requirements to welding coordinators [a]
Technical complexity of welding operation	The levels are directly correlated: — ISO 14731, comprehensive for ISO 3834-2; — ISO 14731, specific for ISO 3834-3; — ISO 14731, basic for ISO 3834-4.
Complexity of equipment used for welding	No correlation, ISO 14731 basic may be sufficient. [b]
Production volume	No correlation, ISO 14731 basic may be sufficient. [c]

[a] One (or more) welding coordinator at this level. Manufacturers employing more than one welding coordinator do not necessarily have to require all to be at the same level. The necessary level depends on the allocated tasks and responsibilities.

[b] At least one welding coordinator should, however, have sufficient specialized knowledge in programming the numerically controlled equipment, welding robots, etc.

[c] At least one welding coordinator should, however, have sufficient specialized knowledge of planning for mass production.

It should be noted that the educational requirements and duration of the training course for the international welding engineer (IWE) diploma are more stringent than those for the international welding technologist (IWT), and likewise between the IWT and the international welding specialist (IWS). A university engineering degree or equivalent is required for IWE and, because of this, a manufacturer may select the IWE qualification in place of lower level qualifications for both ISO 3834-2 and ISO 3834-3.

In some relevant product standards, the level of knowledge required by the responsible welding coordinator should be specified. In such cases, these requirements must be met by the manufacturer. However, ISO 14731 allows welding coordination to be sub-contracted, while the responsibility for maintaining compliance with ISO 14731 remains with the manufacturer.

10.4 Equipment

ISO 3834 requires that a list of key equipment and facilities be prepared and maintained up-to-date. The equipment and facilities should be monitored to ensure they are adequate to manufacture the products concerned.

It is expected that the manufacturer will have implemented a system for the identification, control, maintenance and calibration (where relevant) of all production equipment, including having designated the individuals responsible for these activities and detailed the arrangement to prevent production use of defective equipment.

10.5 Welding activities

The manufacturer should be able to show by means of plans and other documentation (drawings, instructions, specifications, etc.) just how the requirements for completion of production, NDT and other related activities are to be managed and achieved.

10.6 Storage of parent metal

The manufacturer should establish systems for storing parent metals, whether purchased or supplied by the customer, including components provided for incorporation into the finished product. It is expected that the methods and systems will be specified.

10.7 Calibration and validation

Calibration and *validation* are frequently used terms that are not always adequately explained. Their concepts in welding are the subject of ISO 17662.

On the one hand, calibration is the process whereby the item of equipment is tested at intervals against measurement standards whose accuracy in terms of closeness of agreement to the true measurement is known, so that the accuracy of the instrument under test for a given level of uncertainty can be determined.

On the other hand, validation, in the context of measuring equipment, is the process of demonstrating that individual measurements are satisfactory. This can be done by using a calibrated instrument or measurement standard to show that an instrument under test is providing a satisfactory output based on the instrument settings or instrument gauges.

Calibration of welding equipment is generally only required where the quality/repeatability of the weld depends upon accurate and repeatable setting of parameters such as current, voltage, speed, gas flow or pulse characteristics. However, if a power source does not have calibrated meters for current and voltage, the manufacturer should have a calibrated instrument that can be used to verify that the welding parameters (current and voltage) comply with the requirements of the WPS or instruction.

While equipment for post-weld heat treatment and the control of electrode stores is included in the calibration and validation, inspection and test equipment such as NDT equipment and pressure testing gauges is not. As a general rule, inspection and test measuring equipment is always calibrated.

In general, calibration or validation is also required for temperature measurement, e.g. recorders for heat treatment, NDT equipment and pressure gauges. Some dimensional measuring equipment, e.g. vernier gauges and micrometers, requires calibration if the product itself needs that level of accuracy.

Thus, the use of a tongue tester to check the welding current level in a cable, under circumstances where the current was adjusted in accordance with defined settings, or set against an ampere meter on the equipment, would validate the output from the equipment as being satisfactory. In other circumstances, where the tongue tester was used as a meter to adjust the equipment to obtain the right current in accordance with a welding procedure specification, the tongue tester would provide verification that the right current level had been achieved. In this context, there would be no checking of the accuracy of the output of the equipment. Verification, in this sense, is not a calibration or validation process because it only ensures that the designated current level has been achieved.

It should be noted that new welding processes and new power sources, e.g. pulsed arc welding, are difficult or impossible to control without accurate measurement, and suitably accurate instruments are necessary. Control of mechanized welding operations necessitating strict control of heat input also presupposes accurate instruments.

The manufacturer should identify and record the equipment that is to be calibrated and maintain records of those calibrations.

10.8 Identification and traceability

ISO 3834 does not always require identification and traceability. Where the manufacturer has taken on, or is likely to take on, contracts where traceability is required, an appropriate instruction is to be implemented.

Such an instruction should not create confusion with items for contracts which do not require traceability.

When traceability of consumables is required, it is expected that the various batches used in a weld will be recorded, but that it is not necessary to record the location of various batches of approved welding consumables within multi-run joints.

11 Assessment and certification

ISO 3834 does not require any assessment or certification. The manufacturer may, on his own responsibility, declare compliance with a particular part of ISO 3834. As part of this declaration, the manufacturer is required to detail the documents used in the controls implemented. Where these are ISO documents listed in ISO 3834-5, a simple statement referring to ISO 3834-5 is all that is required. This could be the most common application of ISO 3834. ISO 3834, however, may be used to assess a manufacturer by a costumer (second party) or certification body (third party).